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CONTENTS.

	PAGE.
An African Survey	73
Artificial Wood Fibres	75
Butter Fat in Cacao	76
Observations on Biting Sandflies (Ceratopogonidae) in Trinidad, British West Indies	79
The Classification and Evolution of Cotton	82
A New Froghopper Pest of Sugar-Cane ...	84
The Australian Nut	84
The Citrus Product Industry in Florida ...	85
Rubbered Wool Yarns	86
Some Fundamental Principles of Erosion ...	87
Preparation of Tung Oil	88
The I. C.2 Banana in Fiji	89
Blue Mountain Coffee of Jamaica ...	90
Jute Substitutes	91
Reviews	92
Absorption of Growth Promoting Substances by Cuttings	93
Sugar Notes	94
Chemical Notes	95
Trend of the Markets	96

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AN AFRICAN SURVEY.*

THIS remarkable survey of the problems of Africa south of the Sahara originated in a suggestion by General Smuts in his Rhodes Lecture at Oxford in 1929, when he pointed out that Africa was developing under the control of a number of European powers, that different, and often conflicting principles were being applied in the administrative, social, educational and legal fields, but that there was nowhere any survey of what was taking place in Africa as a whole. His appeal for a survey of the extent to which modern knowledge was being applied to African problems was met by the appointment of an authoritative committee and by funds provided through the far sighted generosity of the Carnegie Corporation of New York and later, of the Rhodes Trust. The directorship of the survey was entrusted to Lord Hailey on his retirement from India where he had been Governor of the United Provinces.

It was originally intended that the scope of the survey should be of a general character only but as a result of a year's journey through Africa from the Cape to the Sahara, it became evident that the original conception must be enlarged and the idea of limiting the work to a preliminary report was abandoned. In the author's own words "the sole object for undertaking the survey was the hope that it might prove of some service to the Powers which have possession of territories in Africa, and of some benefit to the African people. It has been felt that this purpose could best be served by a statement as largely as possible of a factual nature, so arranged as to enable the different administrations to appreciate the extent to which their problems are shared by their neighbours, and to inform themselves of the means which are being taken to meet them". This, indeed is an understatement of a work which can only be regarded as one of the most important which has been produced on Africa.

In reality, the survey has been conceived on a most comprehensive scale, its most striking features being its range and objectiveness. Every

*An African Survey : a Study of Problems arising in Africa South of the Sahara. By Lord Hailey. Issued by the Committee of the African Research Survey under the auspices of the Royal Institute of International Affairs. pp. xxviii+1838. (London, New York and Toronto ; Oxford University Press, 1938), 21s. net.

important aspect of the African scene is taken into account. It is not merely a compilation of facts but a very thorough study, succinctly presented, of all the information contained in the survey. It does not confine itself to discussing the state of our knowledge of the problems of the development of Africa but also describes the physical and social background out of which they have arisen, and analyses the factors which must determine their solution. Hence the early chapters deal with the physical background, survey and mapping, climate and vegetation, climatology and meteorology, as well as the African peoples, their divisions and institutions and languages and the agencies for their study, at the same time pointing out deficiencies in scope and method. Next follow chapters on the question of population; and on government, one dealing with its political and social objectives, the other with its structure and mechanism, in the different territories or groups of territories. This leads to an examination of the systems of law and justice and to a brief account of the non-European immigrant communities. Then follows a long and most instructive chapter on the principles and methods of native administration in all African territories, both British and foreign, where the essential issues which should determine opinion on the merits of particular systems of native administration and, in particular, on the system of "indirect rule" are concisely and lucidly treated. Careful consideration is also given to the questions of taxation and labour. The basic question of land is next discussed in the second longest chapter of the book. In this the different land policies in the various territories are described and the question of native land tenure and its treatment reviewed. Next comes chapters on agriculture, forestry, water supply and soil erosion, health and education. Finally, the economic field is covered in five chapters on African development in its external and internal aspects, on co-operative organizations, on minerals and mines, and on transport and communications. In the penultimate chapter Lord Hailey deals with the future of African studies while in the last chapter he presents a lucid summary of the principal conclusions reached on all the subjects dealt with in the survey.

Those whose interests in Africa are mainly agricultural will find a mine of information on the subjects with which they are most intimately concerned. They will do well, however, also to acquaint themselves with what Lord Hailey has to say on the many other matters which affect agriculture indirectly. In Africa, practically everything appears to be interdependent and the survey might well be read with that object constantly in view.

Although no kind of justice can be done here to the wealth of knowledge which the survey contains we would like to draw attention to those parts of it with which this Journal is chiefly concerned—the parts which deal with the land, agriculture, forestry and soil erosion.

In relation to the land, earlier Colonial policy in Africa has been dictated more by the physical character and the economic possibilities of the territory than by considerations regarding the nature of native rights. The immediate need was the development of resources either by the establishment of a European population, involving the alienation of large areas of land, or placing capitalist organisations for exploiting local production through the grant of monopolistic or similar rights over the produce of the land, or again, by the activities of the native population itself, in which case little land was alienated. The precise form used by any state in asserting rights for itself, or in recognizing those of natives, varied according to these circumstances. There are at the present day two principal issues arising out of these policies. The first relates to the nature of the legal rights which states have established over lands in native occupation and to the precautions taken to protect the rights of occupiers when acquiring native land for public purposes or establishing private enterprises. The other relates to the type of legal title which the state is prepared to recognize in favour of individuals, over lands now held on customary native tenures.

As regards the first point the position, in general terms, is that in certain territories all lands are recognized as native property over which the state can claim no rights while, elsewhere, the state can expropriate the great majority of lands in native occupation, subject to certain forms of executive regulations. Thus the survey attaches great importance to the character of the regulations or instructions which control the action of the local authority in dealing with native lands. As to the second point the communal system of landlord holding still prevails over the greater part of Africa and it would be premature to give legal recognition to individual titles. It may be necessary, however, before long, to undertake this process in economically advanced areas.

Agriculture takes a prominent place in the survey. Basic methods of native agriculture, native and European agricultural production, animal husbandry, agricultural research and the improvement of native agriculture and of animal husbandry are all discussed. In the earlier days of agricultural departments, attention was largely directed to finding means for increasing the production of export crops. Of late years, a variety of causes has tended to emphasize the need for the improvement of native subsistence crops. Native agriculture is for the most part based on the system of shifting cultivation, a natural adjustment to the needs of African soils which are for the greater part inherently poor, and which require a considerable period of regeneration after cropping. The settlement of

population in fixed areas and pressure on the soil due to the expansion of economic crops have led to the use of the system in an abnormal manner, with the result that the period of regeneration is unduly curtailed and the vegetal cover destroyed. As regards animal husbandry, the salient facts are that, over large parts of Africa, the tsetse fly makes stock farming impossible; and that in other large areas, particularly in South and East Africa semi-religious values attached to cattle leads to overstocking, which is liable to cause great destruction of pasture and produce erosion.

It is advocated that the first efforts towards the improvement of native agriculture must be to indicate an alternative method for the regeneration of soil after cropping, of which one of the most promising appears to be mixed farming. Its success, however, will depend upon the efforts made to secure protection from infection in tsetse fly areas, and to secure a more economic use of cattle by the natives elsewhere. Other alternatives suggested to the present methods of shifting cultivation, are green manuring, composting, or the like, and, in pasture areas, the introduction of a system of rotational grazing. The survey repeatedly insists that the fundamental problem is how to bring about a permanent system of agriculture. Although native methods of agriculture are rooted in social custom, past experience shows that new methods will be accepted by the people if these can be demonstrated to be adopted to their circumstances.

The question of the relative merits of the development of the "peasant" and "plantation" system of production is regarded as one of the outstanding issues of African economics. There is, however, only a limited field within which the issue has any reality. Certain export crops do not provide an adequate return for capitalist production; there are others in which peasant production can hold its own when quality is safeguarded by official supervision of cultivation or marketing conditions. There remains a few products for which "plantation" methods seem likely to secure a better market but the question whether their production should be encouraged by provision of land or the like is in the last resort mainly one for decision on political as much as on economic considerations.

In relation to forestry it is pointed out that over a great part of Africa the original forest has been destroyed and has deteriorated into savannah. Shifting cultivation, overstocking, grass fires and possibly progressive desiccation of the climate have all been contributory factors. The tropical evergreen forests of Africa are the only ones at present capable of an important export trade in timber to Europe but the survey regards the production of high class timber for export as of less importance than the maintenance and renovation of forest areas for the protection of the water sheds and the prevention of erosion. Particular stress is laid on the need for expanding the forest regime in a number of African territories and for making every effort to secure the co-operation of the African themselves in the preservation of their woodlands. In most territories also a more complete reconnaissance is wanted to determine the limits of possible reservation, and also to gain fuller information as to the stocking of the forests with commercial timber.

The chapter on the state of soil erosion in Africa is written by Mrs. Elspeth Huxley. Up to ten years ago soil erosion had not entered the domain of administration but now it is recognised as a growing menace not merely to the progress of Africa but to the very means of existence of many of the tribes. It is clear that erosion, in so far as it is caused by shifting cultivation and by overstocking, has been accelerated by modern conditions, under which populations are concentrated, more extensive areas of land are cultivated, and the increase of stock is more rapid. The provision of means to counteract the mischief thus done is one of the most serious problems of Africa and it cannot be said that adequate remedial measures have yet been taken in any territory. Also, the difficulties in regard to the introduction of such measures are all the greater in that in some cases they involve fundamental changes in the customs and outlook of the African native. A closer co-ordination of policy between different British territories in regard to this problem than exists at present appears necessary.

Enough has been said, it is hoped, to indicate the immense scope of the survey and the comprehensive way in which it brings together in readily accessible form information that previously was extremely scattered and difficult to collect. It should be of immense value to all those concerned with African problems and will undoubtedly mark a new era in the history of the continent. The very magnitude of the survey, with its masses of data, emphasizes the point that it is very difficult to obtain information on matters which are essential to an understanding of conditions in Africa. To meet this difficulty Lord Hailey pleads for the creation of an official body charged with the central direction of research and of an African bureau which, as a voluntary body, would act as a source of information on practically every aspect of activity in Africa.

ARTIFICIAL WOOD FIBRES.

Among the new fibres and threads may be mentioned the "Hofa" thread produced mainly as a substitute for jute, ramie, hemp, and similar natural fibres. This thread consists of wood fibre stock and viscose, the latter serving as a binder. In contrast to the practice in wood pulp production, the wood fibre stock is entirely freed from "fibre slime" and fine fibre fragments by thorough washing, so that a loose homogeneous fibre structure similar to that of raw cotton results. By suitable spinning and other treatment, a thread resembling horse hair is produced.—(*Ind. & Eng. Chem., News Edit.*, Vol. 16, No. 2, p. 37.)

BUTTER FAT IN CACAO.

By H. C. Doyne and O. J. Voelcker.
(*Department of Agriculture, Nigeria.*)

Butter Fat is an important constituent of cacao, and the actual value of the crop is said to be affected by the amount of this constituent. Van Hall (1) states "one half of the total weight of the marketable bean consists of a fat generally called cacao butter. This substance has an important commercial value, and is used in the chocolate industry as well as in the making of perfumes for pharmaceutical purposes". Knapp (2) gives figures for the approximate composition of skinned beans (Forastero) straight from the pod showing 37 per cent. of cacao butter and 33 per cent. of moisture (equivalent to 55.2 per cent. of cacao butter on dry weight).

The importance of butter fat led the authors to investigate its occurrence in relation to individual trees, botanical variety, methods of preparing cacao beans for market and seasonal variation.

Method of Fat Extraction.

The method of determining the butter fat in samples of cacao at Moor Plantation, Ibadan, Nigeria, was as follows :—

The sun dried beans, either fermented or unfermented, were skinned in order to remove the shell, and the resulting nib was ground up in a small hand mill. Five grammes of this ground material were dried in an electric oven at 105°C until the weight became constant. The oven dry sample was then wrapped in a fat free filter paper and extracted in a soxhlet with petroleum ether for approximately nine hours. The partially extracted material was then removed from the filter paper and ground up in a mortar with clean sharp sand. After the second grinding, the sample with the sand was again extracted for a further nine hours. The excess petroleum ether was distilled off from the extracted oil which was then dried in an oven at 105°C to constant weight. All samples were duplicated. The results are expressed as percentage of butter fat on dried cacao nib.

Table I.

Tree number.	Butter fat percentage on oven dry nib.
T9	56.7
T35	57.1
T38	56.5
T104	57.4
T13	56.5
T75	56.4
T86	57.0
T108	56.9
T15	57.1
T56	56.9
T53	56.8
T95	57.2
T30	57.1
	Average 56.9

Butter Fat in Individual Trees.

The butter fat content of beans from 13 trees was examined. These trees were growing at Moor Plantation and had been selected for high yield. They were from among a population which was probably the first generation of a cross between *Theobroma leiocarpa* Bern. and a Forastero type. A description of these trees has been published by Voelcker (3). All had yellow pods.

Samples were taken from beans harvested in November, 1935 after fermentation for six days in muslin bags along with other cacao. (Table I.)

There is no significant difference between the butter fat content of beans from any of these trees.

Butter Fat in Different Varieties.

Samples of cacao were taken from two plots—one containing yellow pod Forastero—*leiocarpa* hybrids, the other red pod Forastero types, characterized by larger beans. Butter fat percentages are presented in Table II. Averaging from that table the results are as follows :—

Red Pod, fermented and unfermented .... 51.8 per cent.
Yellow Pod, fermented and unfermented .... 51.9 per cent.

There is no significant difference between these varieties in butter fat content.

Butter Fat in Fermented and Unfermented Cacao.

There was not always sufficient cacao to produce fermented samples during the light crop—February to July. Abstracting from the figures given in Table II, the following averages are obtained :—

Red and Yellow pod, fermented .... 52.7 per cent.
Red and Yellow pod, unfermented .... 51.3 per cent.

This difference is significant.*

Butter Fat—Seasonal Variation.

Samples of cacao were taken for butter fat determinations from regular harvests in 1936, 1937 and 1938. Table II gives the results of each determination, and Graph I, based on the same figures, shows at a glance the seasonal variation.

In Nigeria the main cacao season is reckoned to start in August and to continue until January. Cacao produced between February and July is known variously as Light Crop, Mid-season Crop, or Out-of-season Crop. The figures of Table II may be summarized as follows :—

Red and Yellow pod, fermented and unfermented, Main Season .... 54.3 per cent.
Red and Yellow pod, fermented and unfermented, Out-of-season .... 49.3 per cent.

This difference is significant.*

* P = .01.

GRAPH I

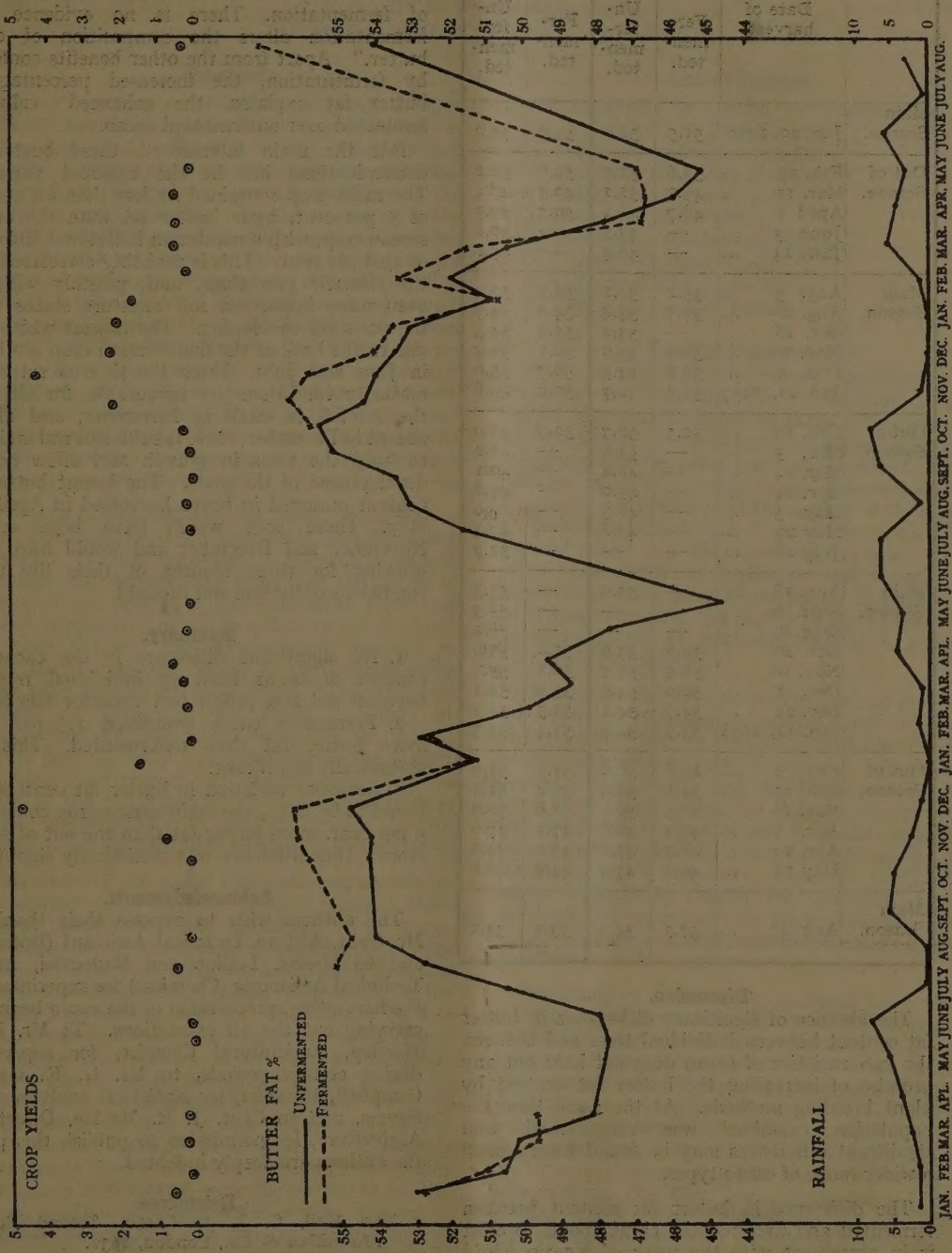
CROP YIELDS
BUTTER FAT %
UNFERMENTED
FERMENTED
RAINFALL
JAN. FEB. MAR. APL. MAY JUNE JULY AUG. SEPT. OCT. NOV. DEC. JAN. FEB. MAR. APL. MAY JUNE JULY AUG. SEPT. OCT. NOV. DEC. JAN. FEB. MAR. APR. MAY JUNE JULY AUG.

Table II.

	Date of harvest.	Red Pod.		Yellow Pod.	
		Fermented.	Unfermented.	Fermented.	Unfermented.
Main Season.	Jan. 29, 1936	51.5	52.9	54.0	54.0
Out of Season.	Feb. 19 ...	51.6	51.0	50.6	50.2
	Mar. 11 ...	49.9	51.1	49.5	49.2
	April 1 ...	48.7	46.1	50.7	50.3
	June 3 ...	—	45.5	—	50.1
	June 24 ...	—	48.4	—	47.6
Main Season.	Aug. 5 ...	55.2	52.1	55.1	53.4
	Aug. 26 ...	54.7	54.4	54.8	53.7
	Oct. 28 ...	—	54.2	55.9	54.3
	Nov. 18 ...	56.3	53.9	56.1	54.4
	Dec. 9 ...	55.6	54.5	56.7	55.0
	Jan. 21, 1937	52.3	52.7	50.6	49.8
Out of Season.	Feb. 10 ...	52.5	52.7	52.7	53.0
	Mar. 3 ...	—	53.6	—	48.1
	Mar. 24 ...	—	48.2	—	49.1
	Apr. 14 ...	—	49.0	—	49.8
	May 5 ...	—	46.3	—	49.0
	May 26 ...	—	41.8	—	47.4
	July 28 ...	—	—	—	51.7
Main Season.	Aug. 18 ...	—	52.9	—	53.3
	Sept. 8 ...	—	—	—	53.5
	Sept. 29 ...	—	—	—	55.2
	Oct. 20 ...	55.8	55.6	55.8	55.6
	Nov. 10 ...	56.5	53.7	56.3	55.1
	Dec. 1 ...	56.0	54.5	55.8	54.1
	Dec. 22 ...	54.7	54.1	53.5	52.9
	Jan. 12, 1938	53.7	52.8	53.4	53.3
Out of Season.	Feb. 2 ...	49.8	50.8	51.6	51.0
	Feb. 23 ...	54.3	52.9	52.4	51.0
	Mar. 16 ...	51.3	50.2	51.8	50.7
	Apr. 6 ...	47.1	48.6	47.3	47.0
	Apr. 27 ...	46.3	47.1	47.0	44.6
	May 18 ...	49.2	47.4	44.6	42.8
Main Season.	Aug. 31 ...	57.3	54.2	57.1	54.2

Discussion.

The absence of significant differences in butter fat content between individual trees and between the two varieties of cacao does not hold out any promise of increasing the butter fat content by plant breeding methods. At the same time the population examined was very small, and significant differences may be found from among a wider range of cacao types.

The difference in butter fat content between fermented and unfermented cacao found to exist is in agreement with the work of Knapp (*ibid.*) who states "during fermentation, the cotyledons lose, by diffusion into and through the shell, a small percentage of theobromine, tannin and other water soluble substances. If fat is lost, the quantity is much smaller, and hence the cacao butter present in the cotyledons increases. The increase is sometimes as much as 2 per cent. and occurs mainly between the second and fourth day of fermentation. There is no evidence that fermentation alters the composition of cacao butter." Apart from the other benefits conferred by fermentation, the increased percentage of butter fat explains the enhanced value of fermented over unfermented cacao.

But the main interest of these butter fat determinations lies in the seasonal variation. The main crop contained no less than an average of 5 per cent. more butter fat than the out of season crop, with a maximum individual difference of 13.8 per cent. This is probably correlated with the climatic conditions, and, possibly with the even more important soil moisture status when the pods are developing. The flowers which give rise to the bulk of the main season crop are borne in June and July. From the time of setting to maturity conditions are favourable, for although the rainfall is small in November, and almost absent in December, there is sufficient soil moisture to keep the trees in growth and allow normal development of the pods. The lowest butter fat content occurred in beans harvested in April and May. These pods would have been set in November and December and would have been growing for three months of their life under conditions of intense soil drought.

Summary.

1. No significant difference in the cacao fat content of beans from 13 individual trees or between red and yellow pod varieties was found.

2. Fermented cacao contained 1.5 per cent. more butter fat than unfermented. This was statistically significant.

3. Seasonal variation in butter fat content was found to be large, the main season crop containing 5 per cent. more butter fat than the out of season crop. This difference was statistically significant.

Acknowledgments.

The authors wish to express their thanks to Mr. Spiff, African Technical Assistant (Botanical) and to Messrs. Ladipo and Bademosi, African Technical Assistants (Chemical) for superintending the harvesting, preparation of the cacao beans and carrying out the oil extractions. To Mr. K. T. Hartley, Agricultural Chemist, for supervision during certain periods, to Mr. G. K. Graham Campbell, Botanist, for statistical analysis of the figures, and to Capt. J. R. Mackie, Director of Agriculture, for permission to publish this paper, the authors are deeply indebted.

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OBSERVATIONS ON BITING SANDFLIES (CERATOPOGONIDAE) IN TRINIDAD, BRITISH WEST INDIES.

By A. M. Adamson.
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Foreword.

Since coming to Trinidad in 1933 I have taken advantage of casual opportunities of observing and collecting small blood-sucking insects, of which the most abundant and irritating, apart from mosquitoes, are the sandflies of the family Ceratopogonidae. In the course of a few years the collections of sandflies were of considerable interest and parts of them were sent to the Imperial Institute of Entomology in London. The Director, Sir Guy A. K. Marshall, was kind enough to forward them to Dr. J. W. S. Macfie, to whom I am indebted for determination of the species. Dr. Macfie has recently published systematic reports (1936, 1938) on the collections and I now add some notes on the habits of the species that suck human blood. These include seven species of the large and well known genus *Culicoides* and one in the genus *Holoconops*.

The facts recorded here are based on collections and observations made personally and by a few others. No claim for extensive research is made—further observations may show that the status of some of the species is quite different from that which is indicated by the records thus far obtained. I have followed the nomenclature adopted in Dr. Macfie's papers. Some of the records given here have already appeared there. The others are based on determinations made by me, by comparison with specimens named by Dr. Macfie. Little previous work has been done on the sandfly problem in Trinidad and the breeding places of none of the blood-sucking species appear to have been investigated. A general account of the problem has recently been written by Myers (1935).

Members of the genus *Culicoides* can usually be recognised easily by their spotted wings. *Holoconops hondurensis* has uniformly clear wings. The only small blood-sucking insects likely to be confused with Ceratopogonid sandflies in Trinidad are the sandflies of the genus *Phlebotomus*, of the family Psychodidae, and the Blackflies or Buffalo Gnats, known locally as Congo Flies, which belong to the genus *Simulium*, in the family Simuliidae. *Phlebotomus* may be recognised by its superficial resemblance to a miniature mosquito. I have been bitten by flies of this genus on very few occasions in Trinidad. It is not known to transmit any human disease here, but species of *Phlebotomus* are known or suspected to be the vectors of sandfly fever, leishmaniosis and other serious diseases in Europe, Africa, Asia and perhaps South America. Two or more species of *Simulium* are abundant and annoying in many parts of Trinidad. They are readily distinguished from sandflies by their larger size and more robust build and by the small red circle which often marks the position of their bites.

List of Species.

(Approximately in Order of Importance as Pests).

1. *Culicoides amazonius* Macfie.
2. *Culicoides diabolicus* Hoffman.
3. *Culicoides stellifer* Coquillet.
4. *Culicoides furens* (Poey).
5. *Holoconops hondurensis* Hoffman.
6. *Culicoides guttatus* Coquillet.
7. *Culicoides debilipalpis* Lutz.
8. *Culicoides pusillus* Lutz.

General Observations.

Biting sandflies are extremely abundant and irritating in Trinidad. Many sea-beaches are almost constantly infested by them and outbreaks of considerable intensity occur with greater or less frequency in most other parts of the island. The principal species according to my observations are *Culicoides amazonius* near the sea, *C. stellifer* and *C. diabolicus* inland, and *C. furens* both near the sea and inland to a distance of several miles. The other three species of *Culicoides* and *Holoconops hondurensis* have been found by me infrequently or in small numbers, but their true status could be ascertained only by extensive records in a large number of localities.

On most sea-beaches, including some of the best for bathing, *Culicoides amazonius* bites viciously at almost any hour of the day except where there is sufficient wind to make it inactive. *Culicoides furens*, *C. debilipalpis* and *Holoconops hondurensis* have been found biting by day on sea-beaches, but much less frequently and in smaller numbers than *C. amazonius*. In many houses near the sea sandflies are a frequent nuisance. *Culicoides furens* is probably one of the principal species involved, but my records are inadequate regarding houses near the sea, and regarding the activities of sandflies near the coast after dark.

According to observations in places more than a few hundred yards from the sea or from swamps of brackish water, attacks by sandflies are much less regular than on the coast. They occur mostly after sunset and fluctuate greatly in intensity. According to reports by residents in St. Augustine, which is about seven miles from the open sea and three miles from the Caroni Swamp, outbreaks of up to several weeks duration occur nearly every year, during the first few months of the wet season, which usually begins in May or June. The species collected by me during outbreaks of sandflies in St. Augustine are mainly *Culicoides stellifer* and *C. diabolicus*. *C. furens* was found biting in houses on only a few occasions. *C. guttatus* and *C. pusillus* were each observed only once in houses in St. Augustine.

Under natural conditions in St. Augustine sandflies bite most intensely about sunset. Their presence in houses appears to be due to the attraction of lights, and they may continue to bite until the lights are extinguished. In my experience they do not bite in houses in the dark, though I have been informed by others that they sometimes do so.

Large numbers of sandflies have often been observed in houses in St. Augustine at times when no bites were felt. The reasons for this variation in habit, as well as for the great fluctuations in the numbers of sandflies observed, are not apparent. They could probably be correlated to some extent with meteorological conditions, but an attempt to do so has not been made.

Reactions to the bites of *Culicoides* in Trinidad, as elsewhere, vary according to the species of insect as well as to the individual victim and the extent of his previous exposure to attack. Swelling and irritation at the site of the bite may persist for periods up to several months in the case of persons who have recently come from temperate regions. A partial tolerance, at least, is usually acquired within a year or less, but a few residents of Trinidad appear to have acquired scarcely any tolerance to some of the species of *Culicoides*.

No diseases are known to be transmitted by sandflies in Trinidad. In the neighbouring island of St. Vincent, however, Buckley (1933 and 1934) observed the complete development of the larvae of *Filaria ozzardi* in females of *Culicoides furens* fed on persons infected by the worms. He suspected that *Culicoides paraensis* also was a vector. I have not seen *C. paraensis* in Trinidad, but it probably occurs there.

The breeding places of *Culicoides* in Trinidad have not been found. *Culicoides furens* presumably breeds in brackish water, especially at the edge of mangrove swamps, as it is known to do so in Honduras, the Bahamas and elsewhere. *Culicoides amazonius*, having been found in Trinidad only near the sea, probably breeds in similar places. *Culicoides stellifer* presumably breeds in fresh water or moist situations inland, and the records of the occurrence of *C. diabolicus* suggest, at least, that it is not dependent on salt or brackish water.

No measures specially designed to control sandflies in Trinidad appear to have been undertaken. The draining of mangrove swamps near the principal towns, Port-of-Spain and San Fernando, however, has probably reduced their numbers very greatly. In other parts of the island little control is likely to be attained or even attempted in the near future. On most of the beaches and other coastal regions infested by sandflies the population is too small to warrant expensive measures. The breeding places of the species that are independent of sea-water, even though they were known, are not likely to be subject to control.

Palliative measures, such as the use of sandfly nets and repellents such as oil of pennyroyal, are described by Myers (1935). I can support his opinion that nets of sufficiently fine mesh to exclude sandflies are not so uncomfortable as is generally supposed.

Culicoides amazonius Macfie.

On sandy beaches along the coasts of Trinidad the most abundant sandfly and the most persistent biter is *Culicoides amazonius*. My collection includes specimens from Balandra, Manzanilla and other beaches on the east coast; Salybia, San Souci and Maracas on the north; Granville on the southeast; and Pelican Island in the Gulf of Paria off Port-of-Spain. I have never taken this species at Maqueripe Bay, the most popular bathing beach near Port-of-Spain. In Tobago I found a single female, near the beach at Speyside on 12th April, 1936. No seasonal variation in numbers appears in the records thus far made. On most of the Trinidad beaches listed above the sandflies may be expected to bite more or less persistently throughout the year and at any hour of the day, except when driven to shelter by a breeze. All of the records of this species are from beaches, at distances of not more than a few yards from the sea.

Culicoides furens (Poey).

This is one of the most widely distributed and obnoxious sandflies in the New World. It has been recorded from the United States, through the West Indies and Central America and as far south as Brazil (Root and Hoffman, 1937). It is the worst sandfly in Honduras (Painter, 1927), and the Bahamas (Myers, 1932), where its breeding habits, in brackish water, have been carefully studied. It is distinguished from other sandflies in Trinidad by the small dark circular spots on the thorax.

In Trinidad I have found this species in many localities on the coast and inland as far as St. Augustine, three miles from the Caroni Swamp. At a house at Mayaro, about 150 yards from the sea on the east coast, I have been bitten on many occasions during the day, but usually where sheltered from sun and wind. Residents in the house informed me that the sandflies—probably all or mostly of this species—were most troublesome near sunrise and sunset. At St. Augustine it has been collected on many occasions in houses at night, but never in large numbers.

A single female was found biting near Pigeon Point, Tobago, on 14th September, 1938.

It is safe to infer from what is known of the habits of *Culicoides furens* in Honduras and the Bahamas, that in Trinidad it breeds in mangrove and other swamps of brackish water, that it is capable of covering distances of several miles from its breeding grounds, and it may be regarded as among the four most noxious sandflies here.

Culicoides stellifer Coq.

In collections of sandflies made at and near St. Augustine the dominant species has been *Culicoides stellifer*. On a few occasions it has been outnumbered by *C. diabolicus*, but the latter species has been found less frequently. *C. stellifer* has not appeared in any of the collections made in places more than two miles from St. Augustine.

It may be inferred that its habitats are restricted, though further collecting will no doubt show that it attains large numbers in many other parts of the islands.

My records at St. Augustine and vicinity cover most months of the year. Large numbers, biting persistently in houses, have been observed most frequently in May, June, July and August, from about 9 p.m. until midnight or even later. Outside it has often been found biting at about sunset. On one occasion I was bitten at 3.30 p.m. in the shade of low forest trees, near St. Augustine, on 1st May, 1935.

The further distribution of this species, as given by Root and Hoffman (1937), includes only the United States. Macfie (1937) states that the arrangement of scutal markings of Trinidad specimens is "similar to, but not identical with, that shown in Hoffman's (1925) figure."

Culicoides diabolicus Hoff.

Records of this species in Trinidad are somewhat similar to those of *C. stellifer*. It has been found in more widely separated districts, but almost always far from the sea, and on certain occasions it has been found biting in very large numbers. My records include St. Augustine, Caura Valley, Sangre Grande, the Montserrat District, all inland, and the Nariva Ferry, which is near the mouth of the river. On a few occasions I have been bitten during the day, between 8 a.m. and noon, in the shade of forests, but attacks by large numbers of the sandflies in houses in St. Augustine have usually occurred after 9 p.m. A great swarm of *C. diabolicus*, along with *C. stellifer*, was seen in a house at St. Augustine on 29th August, 1936.

Myers (1935) writes that the species of sandfly involved in outbreaks near St. Augustine appears to be *C. trinidadensis*, which was described in 1925 by Hoffman, from a single female collected near Port-of-Spain by the late Professor F. W. Urich. Macfie (1937) believes, however, that this is probably *C. diabolicus*.

Culicoides pusillus Lutz.

This small species appears only once in my records, when 5 males and 4 females were taken at light in a house in St. Augustine at about 10 p.m. on 29th August, 1936, in company with great numbers of sandflies of many species. According to Macfie (1938) this appears to be the only record since the species was described from Brazil by Lutz in 1913.

Culicoides guttatus Coq.

A single female was taken biting near the Nariva Ferry, east coast of Trinidad, on 5th July, 1936 at 11.30 a.m. At St. Augustine one female was taken at light on 6th November, 1934 and 4 females on 29th August, 1936. Macfie (1937) believes that *C. diabolicus* may be a variety of *C. guttatus*. The only other records I know are from Brazil and Honduras.

Culicoides debilipalpis Lutz.

This species was collected on only two occasions, at Maqueripe Bay, 6th October, 1936, 2 females, and near Teteron Bay, 16th May, 1936, 1 female, all biting man. According to Lutz and others (1918), sandflies referred to this species were found entering houses in Brazil, whence it was described by Lutz in 1913.

Holoconops hondurensis Hoff.

I have observed this species on only two occasions, both on sandy sea-beaches. At Granville Bay, near the southwestern corner of Trinidad, large numbers of these flies, along with *Culicoides amazonius*, were biting viciously at about 4 p.m. during cloudy weather on 6th January, 1934. A few were found biting, again in company with *C. amazonius*, on Manzanilla Beach in the afternoon of 10th July, 1938, in bright sunshine.

Dr. W. A. Hoffman, who described this species in 1926, from Honduras and Cuba, has informed me that he regards the above name as a synonym of *Leptoconops becquaerti* Kieffer. Bequaert (1925) records sandflies presumably of this species as troublesome near mangrove swamps in Honduras.

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THE CLASSIFICATION AND EVOLUTION OF COTTON.*

THE genus *Gossypium*, to which the cultivated cottons belong, is exceedingly widely distributed in the tropics and sub-tropics. It can be divided into three cytologically distinct groups, (1) the Old World series with n=13 chromosomes, (2) the New World diploid series, with n=13 chromosomes, and (3) the New World tetraploid series, with n=26 chromosomes. The species with commercially valuable lint belong to groups (1) and (3), those of group (2) having only a sparse coating of short hairs on the seed.

The Old World series comprises two wild and two cultivated species. The wild species are *G. anomalum* from the dry regions of West and North Central Africa, and *G. Stocksii* from the deserts of Sind and South-Eastern Arabia.

Of the cultivated species *G. arboreum* is the most widely distributed of all cottons, truly wild representatives occurring throughout the tropical belt of the Old World from West Africa to the Philippines. Wild types of *G. herbaceum* are confined to the bushveld regions of South Africa, and the extension of the species to North Central Africa, Western India and Central Asia only took place in connection with evolution of characters of agricultural importance.

In the New World diploid series there are two sub-groups. The first comprises *G. aridum*, *G. Harknessii*, *G. Armourianum* and *G. trilobum* from the dry regions of Mexico, Southern California and Arizona. They will intercross, giving fairly fertile hybrids and also cross with cultivated New World cottons giving slightly fertile hybrids. The second group comprises *G. Davidsonii* from the coasts of the Gulf of California, the closely related *G. Klotzschianum* from the Galapagos Islands, and *G. Raimondii* from a valley in the Peruvian Andes. *G. Davidsonii* and *G. Klotzschianum* intercross giving a fertile hybrid, but do not cross with the cultivated New World cottons. *G. Raimondii* crosses freely with New World cultivated cottons, but the fertility of the hybrids is not yet known.

Two wild lintless species from Australia, *G. Sturtii* and *G. Robinsonii*, differ widely from all other cottons, but are probably best classified with the New World diploid series.

The New World tetraploid series comprises three wild and two cultivated species. The wild species are all from islands in the Pacific. *G. Darwinii* and *G. tomentosum* endemic in the Galapagos and Hawaiian Islands respectively, and *G. taitense* which is widely distributed from Fiji to the Marquesas Islands. The seeds of all three species have a sparse coating of short brown lint.

Of the cultivated species, *G. barbadense* is distributed throughout Northern South America, the West Indies, and parts of Central America. It may be divided into three varieties or forms. At the centre of origin in the mountain valleys of Colombia and Peru is found the variable group of perennial types described by earlier systematists as *G. peruvianum*. The large leaved, large flowered, long bolled, predominantly kidney seeded type formerly described as *G. lapideum* or *G. braziliense* is indigenous in the forest regions of Brazil, but has been distributed by man in the West Indies. The annual types of recent origin (Sea Island and Egyptian) are probably best described as *G. barbadense* var. *maritimum*.

The varieties of *G. barbadense* are ill defined compared with those of *G. hirsutum*, the second New World cultivated species, in which there are three well differentiated varieties which almost justify specific rank.†

Typical *G. hirsutum* has its centre of origin and variability in Mexico and has spread North and East through the American Cotton Belt. Its var. *religiosum* is indigenous in Mexico, the Gulf coast of the United States, Florida, and the Greater Antilles, overlapping the primary area of *hirsutum*, but extending beyond it. Var. *purpurascens* is indigenous in the Lesser Antilles and on the Spanish Main, and extends South-East into the dry areas of Brazil. There is also an unimportant South-Western extension of its distribution into Ecuador.

All truly wild *Gossypiums* are shrubby perennials. Up to about the thirteenth century the cultivated cottons were also perennials, but during the last 700 years there has been a steady evolutionary trend towards the annual habit in all the cultivated species. With the exception of North-Eastern Brazil and a few scattered areas of negligible importance, the whole of the world's crop is now of annual types. In no other genus has so large an evolutionary change occurred in historic times. It was brought about, first by a series of powerful selective forces all acting in the same direction, and secondly by the fruiting habit of the genus that rendered it peculiarly sensitive to selection for early maturity. All species of cotton have two kinds of branches, monopodial vegetative branches and sympodial

* Condensed from "The Classification of the Cottons of Asia & Africa" by Hutchinson, J. B. & Ghose, R. L. M., *Ind. J. Agric. Sci.* 7, 233, 1937, and "The Distribution of Gossypium and the Evolution of the Commercial Cottons" by Hutchinson, J. B. Conf. of Sci. Res. Workers on Cotton in India, Bombay, 1938.

† The inclusion of all cottons of the Central American group as three varieties of *G. hirsutum* is based on the study of a large living collection that was not available when "The Classification of the Cottons of Asia and Africa" was written. In that paper the varieties *religiosum* and *purpurascens* were separated from *G. hirsutum* as *G. religiosum*.

fruiting branches. Normally, monopodial branches are developed from the lower nodes on the main stem. At a node primarily determined by the genotype of the plant, the first fruiting branch appears, and thereafter only fruiting branches are developed. Selection for early maturity, therefore, results in the isolation and fixation of genes causing the formation of the first fruiting branch lower down the main stem. Other habit changes occur also, but these are secondary to the change in time of appearance of the fruiting branches. The most important of these are changes in photoperiodism and facultative shedding. The perennial *G. hirsutum* var. *purpurascens* is photoperiodic, and only develops fruiting branches during the season of short days. Annual types of *G. hirsutum* are not photoperiodic and develop fruiting branches low down on the main stem at all seasons of the year. Most perennials and some long period annuals (10 to 12 months maturity) are facultative shedders. In such types, even after the development of fruiting branches, all flower buds are shed at a very early stage until the onset of the dry season. In early annual types (6 to 9 months maturity) early development of the first fruiting branch has been accompanied by loss of the facultative shedding habit so that fruit is set in any season of the year.

The more important selective forces in response to which the annual habit has been developed are cold winters in China, Japan, Northern India and the American Cotton Belt, hot dry summers in Peninsular India, and agricultural considerations such as ease of pest control in parts of South India, in Egypt and the West Indies.

In *G. arboreum* annual types have been developed in at least four different areas. In China (except Indo-China) perennial types were introduced as garden plants in the seventh century. By the thirteenth century annual types had been selected and the Chinese types of the present day are so early maturing that they fit into a rotation of three crops per annum. In India the finer types of forma *indica* were developed in response to the needs of a monsoon climate, and the remaining perennial types are now subject to selection for annual habit to facilitate control of boll worm and stem weevil. In Northern India the coarse annuals of forma *bengalensis* made possible the spread of cotton cultivation in regions with occasional winter frosts, and in North Africa also annual types have been developed in forma *soudanensis*.

The evolutionary sequence in *G. herbaceum* is simpler. From perennial wild shrubs of the South African bushveld were developed annual types which matured a crop in 10 to 12 months. These were the cultivated cottons of the Sudan savannah country before the introduction of New World species. They were carried to Western India, where further selection for earliness gave rise to the Kumpta and Uppam types, and to Iran and Central Asia, where in response to a short season and a cold winter the typical form of *G. herbaceum* emerged. The earliest maturing cottons known are strains of *G. herbaceum* from the slopes of the Pamirs.

In *G. barbadense*, selection for early maturity was not begun until the eighteenth century. The first recorded introduction of the ancestors of Sea Island types into Carolina took place in 1786. The annual types selected there in response to the limitations imposed by a cold winter were later successfully established in the West Indies where pests can only be controlled by the enforcement of an annual close season. In Egypt cotton cultivation was initiated with Jumel's perennial, and successfully developed with annual selections from hybrids between the perennial and Sea Island. More recently development in the same direction has taken place in Peru, where the Tanguis variety which grows for about three years has replaced the old long lived perennials. Tanguis was selected for wilt resistance, and as the life of a Tanguis crop is limited by the breakdown of resistance with increasing age it seems likely that the trend towards a shorter crop life may continue.

In *G. hirsutum* annuals of the Upland type probably existed in the drier parts of Mexico before the discovery of America, but their predominance among the world's cottons dates from their spread through what has become the American Cotton Belt. They now form the basis of practically the whole of the Russian crop, the African rain-fed crops, those of Sao Paulo and the Argentine, much of the better quality Indian crops, and a small but increasing part of those of China, Manchuria and Korea. Compared with the early annual *G. hirsutum*, its varieties *religiosum* and *purpurascens* are of little commercial importance. The var. *religiosum*, however, has some very valuable characteristics. Though early enough to produce a good crop in the first season, it is perennial and will persist for many years. Indigenous in Eastern Mexico, the Gulf Coast of the United States and the Greater Antilles, it has become acclimatised and runs wild throughout Africa, in Madagascar, Southern India, the Philippines and Australia. It offers considerable promise as a parent of hybrids with Upland types for climates where pure Uplands are not persistent enough to withstand the sudden onset of the dry season. The var. *purpurascens* on the other hand has not spread beyond its original habitat. It is strongly photoperiodic, and is therefore excluded from areas where by reason of a winter season, fruit must be set in a season of long days. On the whole it has longer and finer lint than the other types of the species, but its agricultural disadvantages are such that it is unlikely to contribute much to the cotton crops of the future.

J. B. H.

A NEW FROGHOPPER PEST OF SUGAR-CANE.

By A. Pickles.
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During the month of January, 1939, severe wilting of canes was reported in a number of fields at Woodford Lodge Estate, resembling the injury caused by the sugar cane froghopper. A severe froghopper outbreak at this time of the year is most unusual and investigation showed that the canes were attacked by a distinct species, *Tomaspis guppyi* Urich. The area affected comprises about 150 acres, including plant and ratoon canes of several varieties; injury is quite severe on Co. 213 which is generally found to be resistant to attack by the common froghopper.

In some fields the injury caused by *Tomaspis guppyi* is already well advanced; in others, numerous nymphs and adults are present, but blight development is only just commencing. Insect populations in many of the fields are very intense, as many as 700 per stool being present in some cases. The effect of adult feeding on the cane leaves is similar to that caused by *Tomaspis saccharina*; pale streaks are developed which later become dry and brown. The juice of plants which have been heavily attacked is already affected and samples show high purity, low brix.

Tomaspis guppyi has generally been considered a somewhat rare insect in Trinidad. C. B. Williams (1921) states that "it is never found on cane and is indeed extremely rare." In cane fields, the species first appeared in 1929 at Ste. Madeleine and subsequently was found on cane at Woodford Lodge in 1935. Since that time, the insect has been regularly present on the latter estate, though never in such numbers as to be of economic importance, until the present time.

The life history of *Tomaspis guppyi* differs in many ways from that of the more familiar *T. saccharina*. The eggs are laid in green leaf tissue near the midrib, in wet cane trash or in damp soil. At the present time, the eggs appear to be laid exclusively in green tissue, probably in response to climatic conditions. The incubation of the eggs occupies 20 days (*saccharina* 14 days minimum) and the phenomenon of "delayed hatching" does not appear to be exhibited; the eggs are very susceptible to desiccation.

The nymphs are usually found high up the stem of the food plant, very rarely concentrated at soil level. Often, a large population of nymphs may be found among the green leaves at the top of the plant.

Tomaspis guppyi resembles and is closely related to the South American species *T. tristis* and *T. suffusa*; by some authorities it is considered identical with the former, which is a cane pest of some importance in Surinam and parts of Brazil. All these species have a marked predilection for very humid conditions and it is probable that the present outbreak of *Tomaspis guppyi* is a consequence of the abnormally wet weather of 1938, during which populations gradually accumulated until, at the end of the year, the insects were sufficiently numerous to be of economic importance.

While it is perhaps unlikely that the outbreak will survive the dry season or will recur in a wet season of more normal rainfall, considerable credit is due to the management of Woodford Lodge Estate for their prompt recognition of the significance of this outbreak and for their energy in combating it. Most of the affected fields have been thoroughly dusted with pyrethrum powder. Where this is impossible, the canes are being burned and reaped immediately and a careful watch will be kept for recurrence of the pest.

A careful watch for outbreaks of this insect should be made in all areas and it is requested that all cases of froghopper blight occurring during the dry season should be reported immediately.

THE AUSTRALIAN NUT.

After a long period of undeserved neglect the value of the Australian nut, *Macadamia ternifolia*, is at last being realized. It produces more oil than any other nut (76 per cent., of the finest quality), it is a food of high nutritive quality, and, most important of all, it is claimed to be the best-flavoured nut in the world. It is grown in north-eastern New South Wales and Queensland, but up to the present its cultivation has not received proper attention. There would seem to be an unlimited demand for this new delicacy in Australia and elsewhere, but only small quantities have hitherto been sold. At times its price has reached 10d. per lb. in Melbourne and Sydney. As the tree responds to care in cultivation, it would be of advantage to plant permanent orchards. The nut thrives in a rainy climate, but in a dry season the yield per tree is comparatively small. Until the nut can be propagated successfully from a commercial viewpoint by vegetative means, a better product must be obtained by seed selection, for it is easy to propagate from seed. But as the young seedlings do not take kindly to removal, considerable care is needed when they are transplanted. The Australian nut has other qualities of commercial importance. It can be used with success as a shade tree, and the hulls, or green coverings of the nuts, contain certain substances suitable for tanning leather.—(*Jr. Royal Soc. of Arts*, Vol. LXXXVI, No. 4475, p. 1004, 1938.)

THE CITRUS PRODUCTS INDUSTRY IN FLORIDA.*

Six years ago the Federal government established a laboratory at Winter Haven, Florida, to investigate the utilization of citrus fruits unsuitable for the fresh fruit market because of size or colour, and to devise means for recovering by-products from cannery waste. The most important problem was to find some means of packing orange-juice so that its aroma and flavour would be wholly retained during a storage period of nine months to a year. This has been partially achieved by proper extraction, deaeration and flash pasteurization and storage in enamel cans at temperatures of about 60°F. (1). Such juice will not have, however, the full aroma and taste of that from fruit just picked from the tree. Deaeration and flash pasteurization are distinct improvements over the older, "exhaust-box", method of processing both orange and grapefruit-juice. During the work, a new type of de-aerator has been developed which is cheaper to construct than other equipment of this type on the market (2).

There are many theories regarding the development of off-flavours during the storage of canned orange-juice. It is certain, however, that oxidation due to the oxygen in the air left in the juice after canning plays an important rôle in this change. The edible portion of oranges is said to contain 0.2 per cent. fat, and although this is an extremely small amount, it may have some bearing on the development of off-flavours in canned juice. When fats undergo certain chemical changes, they are split into other substances some of which may have a very objectionable odour and taste. From preliminary work on the free acids of the fat of orange-juice, it has been found that these acids are much more plentiful in old canned juice than in freshly-expressed juice. It ought perhaps to be pointed out that these fatty acids should not be confused with citric acid. The change in free fatty acid content may be significant, and further work is being carried out with the view of determining the nature of the fat in orange-juice. The results may not only be of importance in solving the problem but they may also perhaps contribute to a better understanding of the nutritive value of orange-juice.

During the past few years, the production of cold-pressed orange and grapefruit oil from peels has increased, and at present both are produced in Florida, either by grinding the peels of the fruit, or by passing the peels between revolving ribbed drums. In both methods, an emulsion is obtained from which the oil is separated by means of centrifuges. It should be noted that the emulsion cannot be allowed to stand for any length of time before the oil is separated without impairing the flavour of the oil. The manufacturer of orange oil in Florida does not attempt to blend his different batches to obtain a uniform product, nor does he apply technical control.

After the peel has been pressed, there is still some oil left which can be recovered only by steam distillation. The yield of steam-distilled oil is higher than cold pressed oil. Steam distilled orange oil commands a lower price than cold-pressed oil, and finds uses where a cheaper oil is desired.

A small plant for extracting the oil from grapefruit seeds has been established at Winter Haven. Briefly, the method consists of subjecting the seeds to a short fermentation to loosen the slimy coating, drying to the proper moisture content, and then expressing the oil. The oil which is expressed by means of automatic expellers, is allowed to settle and then clarified by pumping through plate-and-frame presses. It is pale amber in colour and possesses a pleasant aroma and bitter taste. The bitterness may be removed by proper refining which at the same time bleaches the oil until it is nearly water-white. The preparation of grapefruit seed oil yields two products: the oil and the press-cake. The properties of the press-cake and its industrial possibilities have not yet been investigated.

About three years of research were spent on the chemistry and preparation of alcoholic beverages from citrus fruits (3). This work has now been stopped. In the fiscal year ending June, 1937, 24,886 gallons of still wine were produced in Florida.

Feeding tests by Mead and Guilbert 12 years ago showed orange pulp to have a high content of digestible nutrients (4). The drying of orange peel and pulp was carried out in California ten years ago (5). Recent work by Neal, Becker and Arnold (6) has shown the value of grapefruit cannery refuse and dried orange peel as a foodstuff. The dehydration of cannery residues has now become an important industry in Florida. The liquid pressed from the material prior to drying, the disposition of which has caused public health authorities some concern, may amount to from 20,000 to 50,000 gallons per day. A partial analysis of this material is shown in Table I.

Table I.—Partial Analysis of Liquid Waste from Citrus Drying Plants.

	Plant 1.	Plant 2.
Total Solids per cent. ...	6.26	4.88
Ash per cent.	0.50	0.48
pH	8.8	7.7
Pectin per cent. ...	0.58	0.54
Total Sugars per cent. ...	2.78	2.44

It will be seen that the waste liquor contains a significant amount of solid matter, including sugars, which subsequently ferment, creating obnoxious odours. The material is so concentrated

* Summarised from "The Chemist Looks at the Citrus Products Industry in Florida" by H. V. von Loesecke. *The Citrus Industry*, Vol. 19, No. 6, pp. 6-7, 19, 1938.

that it defies ordinary sewage treatment. At the present time, it is being disposed of by lagooning which is only a temporary solution, and also by trucking away in tanks. It is not entirely impossible that the waste could be fermented with special organisms, not to recover alcohol, but to obtain certain organic acids of technical value. This is now being investigated.

The disposal of the wash waters from canneries is another problem. These washings containing sugar, pectin and other organic materials are allowed to flow into lakes where they have proved in some cases to endanger fish life. Work has accordingly been started at Winter Haven to find some method of treating the waste so that it may be disposed of without becoming obnoxious and without danger to wild life.

With regard to the bacteriological aspect of the canning of citrus juices, several bacteriological counts have already been made of raw juice and pasteurized juice in different canneries. Various yeasts, moulds and bacteria have been isolated, but have not as yet been identified. Work of this type has been extensively pursued and found valuable in tomato juice production, and there is no reason why it should not prove equally valuable in the canning of citrus juices.

The question of preparing pectin from grapefruit residue has been a much disputed topic. At present very large quantities are prepared in California and elsewhere from apple pomace. Its manufacture, however, requires the highest type of technical control and this means high manufacturing costs. Pectin finds its greatest use in the preserve and confectionery industries. To increase the demand for pectin new uses must be found. Recent work in Germany has directed attention to the possibilities of pectin in the preparation of lacquers, but with the price of pectin at $1.00 per pound and with sulphite pulp and cotton linters (the present basic substance of lacquers) considerably cheaper, there seems to be little hope here. Work has been recently carried out in this country on the use of pectin as a bactericide, and as an aid in promoting the healing of wounds (7). Many clinical tests will be required before any reputable physician would prescribe pectin for this purpose. Should such tests prove successful, the outlet for pectin in this field would be limited. The value of pectin in the treatment of infantile diarrhoea is now recognized by all physicians (8). Another use for pectin is the production of suspensions of barium sulphate for use in X-ray where it is essential that the barium sulphate meal ingested by the patient remain in uniform suspension as it passes through the alimentary canal rendering it opaque to X-rays and disclosing any abnormalities on the photograph taken by the physician. Thus progress has been made in discovering new uses for pectin, but outlets which will consume large amounts of the material must be found. Then, too, work should be directed towards establishing the constitutents of citrus pectins, because very likely there is a difference in combination of these constitutents in pectin from oranges and grapefruit.

Orange and grapefruit oils find their use limited to the flavouring field and to an even more limited extent, in the cosmetic industry. Here, too, new uses should be found. The quantity of flavouring constitutents in these oils is extremely small, amounting to less than five per cent. The other 95 per cent. consists of substances the chemist classes as terpenes which contribute little or nothing to the aroma of the oils. Theoretically, camphor could be made from orange or grapefruit oil. But it would not pay, because one would have to compete with turpentine and other raw materials much cheaper than citrus oils.

Briefly might be mentioned the need for a search for new uses for naringin, the bitter principle of grapefruit, and for hesperidin, a substance of the same chemical family and found in oranges. Both these substances may be easily and cheaply separated from refuse fruit. New uses for cannery refuse other than drying for cattle food should be found. The freezing of citrus juices, especially tangerine juice, should be investigated. The technical aspects of preserving foods by freezing have made tremendous strides during these eight years and frozen foods have become an important article in the diet of this country, in some instances replacing the fresh commodity. A comprehensive study should also be made of the factors responsible for the decrease in vitamin C content of citrus juices during processing and subsequent storage.

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RUBBERED WOOL YARNS.

The Wool Industries Research Association in its annual reports for 1936-37 makes mention of successful experiments in the rubber treatment of wool yarns. It is possible, according to the association's report, to rubberise wool yarns in hank form with a suitably prepared latex without any matting. The wool can be dyed either before or after treatment, and the colour may be applied, if so desired, in the latex itself. The process is expected to give favourable results in the manufacture of strong yarns with little twists, and of felt. It is also recommended for special purposes, such as water-resistant or mothproof fabrics.—(*Ind. Eng. Chem., News Edit.*, Vol. 16, No. 4, p. 112).

SOME FUNDAMENTAL PRINCIPLES OF EROSION.

It has so far proved impossible to express the problems of erosion in terms of known physical laws. Hydraulic engineers have evolved certain empirical rules for its prediction, but these do not appear to have universal application. According to Dr. E. G. Richardson* of King's College, Newcastle, England, the chief factors deciding the amount of stream erosion are :—

(*a*) the degree of turbulence of the water,
(*b*) the magnitude of the "gradient of velocity" over the soil surface,
(*c*) the size, shape and density of the soil particles,
(*d*) the compactness of the soil.

The gradient of velocity of a stream or runnel is determined by the change in velocity at increasing distances from the bed; it is a fundamental factor in the modern theory of stream erosion, and is a more useful conception than mere surface velocity. For a given gradient of velocity, provided a stream is sufficiently turbulent to cause adequate mixing, erosion varies inversely as the size of soil particles having the same density. At increasing distances vertically above the bed within the turbulent stream, the concentration of soil particles ("silt") diminishes exponentially with the magnitude of the height; hence the slope of the straight-line graph obtained by plotting heights against logarithms of silt concentrations, furnishes a measure of what may be termed the "coefficient of erosion". Silt concentrations were measured by Dr. Richardson by a photo-electric method applied to graded sands moving under the action of water down glass-sided wooden channels. In this way, experimental evidence was obtained which proved the exponential or logarithmic law.

It has often been reported by hydraulic engineers that *colloidal* particles are less easily eroded than particles of larger magnitude. For soil comprising grains of heterogeneous size, a maximum rate of erosion seems to obtain for diameters around 0.1 millimetre (the "fine sand" grade in soil texture analysis). This apparent anomaly is now explained by the fact that the velocity gradient is not the same in moving water carrying colloidal material as in a homogeneous fluid, or in a stream containing sparsely-distributed particles of relatively large dimensions.

The permeability of a soil to water as determined by its natural structure is the first factor to operate in erosion. A highly permeable soil allows water to penetrate easily and so to gain intimate contact with the structure units. If these are unstable or incoherent, readily disintegrating into small discrete grains, then the particles are floated apart, and those lying near the surface may be lifted bodily into the stream and rapidly removed. Soils having single-grain structure are thus very prone to erosion, especially if the size of the grains is uniform and small (around 0.1 mm.). If, however, the structure is crumbly and the aggregates are large and stable in water, or if it is coarse and the particles are heavy, then a greater velocity gradient is required to disturb the grains, and the soil strongly resists erosion.

A very deep permeable soil may absorb all the rain that falls on the ground, and eroding streams may fail to develop, but a permeable *shallow* soil, underlain by an impervious bed, readily becomes waterlogged and either slowly moves bodily down hill ("hill-creep"), or rapidly fills with water so that runnels develop over its surface. On the other hand, a fine-textured soil having *low* permeability may permit only the surface layer to become saturated, and streams may develop before downward penetration has proceeded very far. Slow penetration may greatly alter the distribution of velocity near the bed through the successive floating off of soil particles, so that a quasi-solid layer is formed at the surface, and this may diminish the load that can be carried in suspension.

Application to Customary Methods of Erosion Control.—One of the chief methods advocated for controlling erosion is to reduce the overall slope of the land by constructing terraces, or by creating barriers of vegetation. These procedures would seem to be merely palliatives. Although a reduction in the angle of slope over the surface of a terrace may be very effective in minimising erosion, the water-level may rise rapidly during rains, so that, unless the soil is very permeable and deep, the land may become waterlogged and de-aerated. In extreme cases, the waterlogged soil may slip and break down the terrace, spilling water onto the lower grounds. Hence, *in regions of heavy rainfall, terracing should be practised with great caution,* and in all cases provision should be made for the adequate drainage of the tiers, especially when the soil is not very absorptive. Such modification of the terracing system, namely the provision of drainage and run-off from the backs of the terraces, greatly complicates their construction, and necessitates careful planning over large areas within which outlet channels for the terrace drains must be accommodated.

As Dr. Richardson points out, a much more satisfactory procedure would be the provision of barriers which *reduce velocity gradients while not unduly impeding the run-off.* In the case of large rivers, this object has been achieved by constructing a series of transverse check-dams or shallow weirs placed at short intervals over the bed. These reduce water-movement over the bed almost to a standstill, yet do not retard the main flow. Application of the same principle

* *Nature*, Vol. 142, No. 3588, 1938, p. 236.

to the control of sheet erosion on agricultural lands suggests the close sowing of low-growing herbage which will impede the immediate flow of surface water within, say, an inch of the surface while not hindering the run-off of the bulk of the water. In stony land, a similar result might be attained by placing small boulders in rows at intervals across the slopes, and in land being cleared of forest for agricultural utilisation, thin logs of wood or stems of bamboo might be used for providing shallow barriers, at least until the slopes have been stabilised by the establishment of some permanent system of agriculture.

F. H.

PREPARATION OF TUNG OIL.*

SINCE its inception in 1929 the Imperial Institute Sub-Committee on Tung Oil has been engaged upon the encouragement of the production of tung oil in the British Empire, and among its varied activities it arranged, in collaboration with the Royal Botanic Gardens, Kew, for the distribution of seed for cultivation trials in those countries where climatic conditions appeared to be suitable for the growth of tung trees.

As an outcome of these experimental trials, various planters and companies have established plantations of tung trees with a view to the production of tung oil on a commercial scale. These plantations are to be found in Assam, Burma, Nyasaland, South and East Africa, Australia and New Zealand and vary in size up to about 5,000 acres.

In many cases some of the trees are now beginning, or are about to begin, to yield fruit in appreciable quantities, and the Imperial Institute is constantly receiving inquiries from planters and others as to the most suitable means of disposing of their crop and of preparing the oil. In view of this interest the following information is published.

There are two alternatives open to planters desirous of marketing their produce, viz.: the sale in the form of nuts or as oil. A decision as to the best course to adopt must be left to the judgment of the grower. To aid him in making a correct decision it may be pointed out that if the oil is to be prepared *in situ* on a plantation a large supply of fruits must warrant the initial outlay entailed in the purchase and erection of suitable plant. As an indication of the capacity of the smallest crushing plant recommended as being suitable for the purpose, it may be mentioned that such a model is able to treat in the course of 150 working days, the produce from 200,000 trees in bearing. Such a large quantity will be available only on a plantation of considerable acreage or from a group of smaller estates situated in one locality. It may, however, be the case in some districts that other oilseeds are available which might be crushed in the same plant, with or without modification, during part or the whole of the period when it is not being used for tung seed.

Preparation of tung oil on a plantation or a group of plantations has the advantages that the freight charges on the oil are naturally less than those on a sufficient weight of nuts to produce the same quantity of oil—a very important factor in some countries—and that the residual oil-cake can be returned in some form or other to the plantation as a fertiliser. On the other hand, oil will require suitable containers, the provision of which may be an expensive item in some parts of the Empire.

In cases where for one reason or another the oil is not prepared on the spot, the fruits will have to be dehusked and the nuts, *i.e.* the kernels still enclosed in the surrounding thin, brittle shells, after being well air-dried, bagged for transit for crushing in an existing oil-mill either in the country of production or overseas. Where labour is cheap the dehusking of the fruits may be accomplished by hand, with, or without, previous fermentation of the fruits. In China the fruits are allowed to stand in heaps covered with grass, leaves, &c., when the husks are decomposed by fermentation and after about a month the nuts can be separated easily by hand from the mass. Trials using this fermentation method carried out on behalf of the Imperial Institute Sub-Committee on Tung Oil by the Department of Agriculture, Nyasaland, have shown that this method is more suitable for *A. fordii* fruits than for those of *A. montana*, the husks of the latter being more resistant to decomposition than those of the former. If carefully performed so as to prevent the temperature of the mass rising too high, the fermentation method has no adverse effect on the quality of the oil. An alternative method is to dehusk the fruits mechanically using either a hand or power-driven decorticator, the nuts being separated from the broken husks by hand or by a mechanical separator.†

In China the first step in the preparation of the oil consists in drying the nuts. For this purpose they are spread out in a thin layer on the ground in the sun and allowed to dry, being stirred at frequent intervals by means of a wooden scraper. In good drying weather the shells begin to break open spontaneously on the second day, and on the third day they are thoroughly flailed to remove the shells. The kernels are then separated from the shells by throwing the mixture a shovelful at a time into a fan-shaped heap. This results in the chaff falling near by, the shells a little further off, while the kernels travel to the periphery of the heap. The separation is completed by hand—picking out any kernels that may still be left among the shells. The kernels are then ground in a circular trench, lined with stone,

* Abstracted from *Bulletin of the Imperial Inst.*, Vol. XXXVI, No. 3, 1938, pp. 357-360.

† *See Bull. Imp. Inst.* 1936, **34**, 360.

by means of a heavy stone wheel rolled around the trench and drawn by bullocks. The ground kernels are sifted through a large bamboo sieve of 4 mm. mesh and the coarser particles returned to the trench for further grinding. The sifted meal is steamed for 2 minutes over boiling water and then formed into circular cakes surrounded by straw and iron bands. Thirty of these cakes are introduced into a native press made by hollowing out a large sound log of hard wood or of large squared timbers morticed together. Pressure is exerted by driving a series of wedges into the press. After the kernels have been under full pressure for an hour the cakes are taken out of the press and the adhering straw removed. They are broken up and partially ground in the crushing trench. The coarsely ground material is heated in an iron vessel over a fire to remove moisture absorbed during the early steaming process and then re-ground, sifted, steamed, formed into cakes and submitted to pressure as before. The total yield of oil obtained as a result of these two pressings is stated to be 50 per cent.

In the case of the treatment of fruits from the recently established plantations in the United States and the British Empire modern machinery is employed. If the oil is to be prepared on a plantation the fruits are either sent direct to the factory unhusked, or if the distance to the factory is considerable the fruits may be roughly dehusked by small portable decorticating machines and the dehusked material transported to the crushing plant, the husks being returned to the soil. In the case of plantations not equipped with oil-crushing plant the product that reaches the factory where the oil is prepared will be in the form of nuts.

At the oil-mill the raw material, whether in the form of fruits or nuts, has to be further decorticated so as to get it in a condition suitable for pressing. The more common type of decorticating machine for tung products consists of two saucer-shaped discs with ridged surfaces, one disc being fixed and the other capable of rotating at high speed. The distance between the two discs can be adjusted to suit the size of the fruits or nuts. The fruits or nuts are introduced into the hopper of the decorticating unit and the husks and shells are broken therein. The broken products and the kernels fall on to a sloping screen of such mesh that as the material travels down it the kernels fall through on to a lower tray and are thus separated from any whole fruits or nuts still in sections of the fruit, while the broken husks and shells are lifted by suction and discharged. The separated kernels are delivered over the end of the lower tray and before leaving it are again aspirated to remove any remaining small pieces of husk or shell. As the presence of a certain proportion of shell in the kernels assists the expression of the oil, the decorticator and separator are so adjusted as to allow the desired percentage of shell to remain with the kernels. About 15 per cent. of shell in the kernels has been found to be a suitable proportion.

After decortication the kernels are ground in a disintegrating mill and are then introduced into the press. Experience has shown that the expeller type of press is the most suitable for tung seed. The ground material on entering the expeller plant, first passes through the tempering trough where it is treated with steam whereby the walls of the oil-containing cells are disrupted and the oil rendered more fluid. Correct tempering of the kernels is an essential for the efficient expression of the oil. The tempered meats are discharged into the expeller proper, where they are crushed, the oil percolating through the interstices of the box and the cake leaving the press at the end opposite to the one at which the meats entered. The oil is allowed to stand in tanks for a few days, during which the bulk of the foots are deposited and the clear supernatant oil can be then drawn off and put into drums. If considered desirable, the oil may be passed through a filter press before being put into containers. The resulting oil-cake, containing 7 per cent. or less of oil according to the efficiency of the crushing, is only suitable for use as a fertiliser, feeding trials carried out on behalf of the Sub-Committee on Tung Oil at the Rowett Research Institute, Aberdeen, having shown it to be unfit for use as a feeding-stuff for animals.

THE I.C.2 BANANA IN FIJI.*

In connection with a previous article (1) on new banana varieties at present being grown at the Central Agricultural Station the following extract from a report recorded from the Auckland agents (Messrs. Turners and Growers, Ltd.) on two cases of I.C. 2 bananas shipped in February last may be of interest :—

"On opening the two boxes, the Veimama were still quite firm and green but the other bananas (*i.e.* I.C. 2) were mostly golden yellow and a few spotted. However the smaller size fruit was still green. The flavour appears to be excellent, but the bananas are apparently more delicate than the Cavendish and Veimama.

I should imagine that this variety of banana would prove to be more popular with the public if we could handle them in large enough quantities to cultivate the public taste. In the meantime I would like you to send more when you have them available . . ."

Inasmuch as this variety continues to show practical resistance to leaf spot disease in the field, this report on the market possibilities of the fruit indicates that it may prove a useful addition to the commercial banana varieties of the Colony.

Reference.

(1) Parham, B. E., "New Banana Varieties for Fiji", *Fiji Jr. of Agric.*, Vol. IX, No. 2, 1938.

* *Agric Jr.* Fiji, Vol. IX, No. 3, 1938.

BLUE MOUNTAIN COFFEE OF JAMAICA.*

THE coffee plant was introduced into Jamaica early in the eighteenth century, during the period of general dissemination of the tree from the eastern to western hemispheres. The cultivation of coffee increased rapidly and steadily until 1814 when 34,000,000 pounds were exported. The occurrence of floods and hurricanes during and immediately following 1815, together with the abolition of slavery, caused most of the large plantations to be abandoned.

At the present time Jamaica furnishes 0.3 per cent. of the world's coffee and ranks sixteenth among the exporting countries. The normal annual export averages about 10,000,000 pounds although slightly less than 8,000,000 pounds per year have actually been shipped in the last ten years. The Blue Mountain coffee, to which this paper is devoted, accounts for only 2.5 to 3 per cent. of Jamaica's production. The annual production therefore amounts to only about 250,000 pounds, an insignificant figure in comparison to the world's total. There are two other coffees grown bearing the name Blue Mountain, Blue Mountain Valley and triage. These are grown at altitudes below 5,000 feet and do not compete with the true Blue Mountain because of their lower quality.

Producing Areas.

This fine coffee is produced on lands from 5,000 feet to the tops of the highest peaks in the Blue Mountain system of eastern Jamaica (7,360 ft.). The farms or plantations are located on the southern or leeward slopes. The two parishes of St. Thomas and St. Andrews produce the bulk of the high-grade crop, as they occupy the leeward sides of the highest elevations.

Climate.

The climate on the southern slopes of the Blue Mountains is probably unsurpassed for the production of coffee. The precipitation, mainly orographic and brought by the north east trade winds, is sufficient on the leeward slopes at high altitudes. There is too much rain on the windward side where the annual precipitation is over 200 inches in many places. The leeward slopes are not as dry as might be expected in the trade wind belt because the Blue Mountains are composed of a series of peaks reaching elevations as high as 7,360 feet but separated by passes whose altitudes are from 2,000 to 5,000 feet. There are two wet periods, one less wet, and one relatively dry period during the year, although no month is entirely rainless. The annual precipitation at Hill Gardens (altitude 4,907 feet) in the Blue Mountain coffee region is 105 inches. The north east trades are the most active and bring the heaviest precipitation from March to June and September to December. The equatorial calms of June, July, and August favour sufficient convectional rainfall to carry the crop through the summer months. The clear cooler calms of the low sun period from December to March bring drier conditions which aid in ripening and drying the crop, and also give the coffee tree a chance to overcome some of the fungus diseases which thrive in the warm humid air of the rainy seasons. The fact that mists, cloud, and fog cover the sun during the warmest part of the day, together with the high altitudes, makes shade for the trees unnecessary. The temperatures are quite constant, both seasonal and diurnal. At 7,000 feet the extremes of temperature vary from 55 to 70 degrees while at 3,000 feet, they vary from 68 to 82 degrees Fahrenheit.

Soils.

The soils of the Blue Mountains are quite varied. The parent materials consist of limestones, shales, conglomerates, and basaltic lavas. The soils developed on the basaltic lavas and limestones are friable and allow good subsoil drainage with less surface erosion. These soils also allow uncramped tap root development which is a requirement for successful coffee growth. The basaltic soils are basic and are high in phosphorus, iron and potassium but become deficient in nitrogen rather early, unless animal or commercial fertilizers are applied.

Characteristics of Coffee.

The Blue Mountain coffee tree belongs to the species *C. arabica*, the same variety as is grown on most parts of the island, as well as in most coffee producing countries. The rare flavour of Blue Mountain coffee then is not due to the species grown, but seems to be a combination of altitude and peculiar soil and climatic conditions, where growth is uniform but slow. The coffee bean has a blue green colour that makes a good appearing roast. It is bullety, and the seed contains much oil. The caffeine and acid content is quite high. Due to its outstanding quality, the finest coffees of the world are compared with it. It is said that Mysore coffee from Nilgire, India, compares favourably with the best Jamaican coffees.

Plantation Practices.

The coffee plantations are predominantly small. They are usually less than 100 acres with the majority under 50 acres. The larger holdings are remnants of still larger plantations owned by an absentee landlord and under the direct supervision of a resident overseer. There are many small holdings owned by the native occupants. These producing areas grow sustenance crops for the owner's family, in addition to the cash crop coffee. The estates are situated on such steep slopes that cultivation is very difficult. The steepness of the land makes hand labour necessary for all operations. Road-building is so expensive that the poorest transportation facilities

* This article by H. E. Hoy is reproduced from *Economic Geography*, Vol. XIV, No. 4, pp. 409-12.

in Jamaica are found in the Blue Mountains. The most common method of transportation for man as well as for freight is by horse or donkey along the narrow mountain trails.

The crop ripens and is harvested during the dry period from December to March. As might be expected, the yield is small, averaging less than 90 pounds per acre. The preciousness of the product allows no waste or consumption on the plantation. An observer in the area was told by the overseer of a plantation that to his knowledge not a berry of Blue Mountain coffee had been consumed on that plantation in the forty years he had served. Intensive methods are employed in gathering, cleaning, and drying before the coffee is transported by pack animal to Kingston where all Blue Mountain coffee is graded and nearly all is shipped direct to England. There the coffee is used as a blend and is marketed under several trade marks. In 1936 a Jamaican firm began roasting a small amount for local consumption.

Price.

At first thought it is rather unusual that the price of Blue Mountain coffee has remained nearly constant while at the same time there have been great price fluctuations in other coffees. This is due largely to the small offering each year and to the limited area for expansion. Since 1895 the prices at Kingston have fluctuated between $25 and $50 cwt. The number one grade has suffered less fluctuation.

Future.

What is the future of Blue Mountain coffee likely to be? With a market price as much as five times as great as for ordinary grades, it would seem that there would be a rapid expansion and increased production of this coffee. However, several unfavourable factors exist which prevent overproduction. In the first place the potential area at altitudes above 5,000 feet is distinctly limited. The ruggedness of the land renders much of this potential area impossible for cultivation. The cost of cultivating this steep land is higher than the cost where machinery can be used. The yield per acre is much lower than that from plantations at lower altitudes. The labour supply is adequate but the wages are relatively high. Experiments have been conducted at lower altitudes to increase the yields with applications of sheep manure. An application of two pounds of fertilizer per tree per year steadily increased the yield from 220 pounds to 580 pounds per acre in a five-year period. If sheep could be made to thrive in the Blue Mountains, an important side industry to coffee production would be developed, as nitrogen is one of the elements most lacking in the soil of the region.

Summary.

In summary there are various reasons for the high rating given Blue Mountain coffee. A rich friable and basic soil which is conducive to good coffee is found in the Blue Mountains. There is a fortunate combination of favourable temperatures and well distributed rainfall. There is a good soil and climate at altitudes most favourable for slow growth of fine coffee. A relatively plentiful supply of intelligent labour lives in the Blue Mountains. A scientific system of sorting and grading is carried on. Jamaica has enjoyed a more stable government than any of its neighbours in Latin America. England, who furnishes the market for all Blue Mountain coffee, has not been cut off by wars or other disturbances. A preferential tariff by the United Kingdom has given Jamaica an economic advantage over other West Indian Islands. There is a progressive and interested governing country ready to aid and improve both quality and quantity. Blue Mountain coffee has been able without ballyhoo of advertising to reach its high place in the coffee world.

JUTE SUBSTITUTES.

According to the information contained in the *Bulletins* of the Indian Central Jute Committee, a new Italian company has been floated in Ethiopia with the object of cultivating fibres which can serve as substitutes for jute in East Africa.

The Department of Agriculture, South Africa, has been experimenting for some years with Brown Hemp, or *Hibiscus canabinus*, indigenous to South Africa, and has come to the conclusion that this annual, which often reaches a height of seven feet, can be cultivated on a wide scale and used as a substitute for jute. *Hibiscus bifurcatus*, a native plant of Brazil, has been found to be useful as a substitute for jute in that country.

A new type of heavy paper suitable for the manufacture of sacks has been made by Dr. Tunji Torii, Chief Chemist of the Japanese Bag Company, Tokyo. The product is reported to be better than hemp or leather, in resisting water and sand, and it is claimed that its strength increases when left in water for prolonged periods. In Manchukuo, *Kenaf* is being cultivated on a large scale with a view to substituting it eventually for jute.

In the Belgian Congo, *Urena Lobata* and Punga fibres, which were introduced in 1930, have achieved a position of relative importance as substitutes for jute.

Rosella is being cultivated in Java, and *Rosella* bags are being extensively employed in the sugar trade in place of jute bags. It is expected that unless unforeseen circumstances arise, Java will become self-supporting in three to four years, at least so far as sugar bags are concerned.—(*Current Science*, Vol. VII, No. 6, p. 301, 1938.)

REVIEWS

SCIENCE IN AFRICA.

By E. B. Worthington, M.A., Ph.D. (Cantab.). *Oxford University Press*, London 1938, pp. 746. Price 10s. 6d.

In the Foreword to this publication, Lord Hailey explains that the volume began as a factual memorandum for the purpose of the African Research Survey, but subsequently was felt to merit development into its present form—a very comprehensive account, covering over 600 pages, of the research work in progress in Africa today.

It is clear that every possible effort has been made to ensure real accuracy in this survey. Apparently summaries of the various chapters and subjects were originally prepared by Dr. Worthington himself and submitted in draft for revision by the research workers in the various African Colonies; and then finally, after that, each chapter was again revised by a leading "home" authority upon its subject. As the result of all this care, the book gives us a general review of the many problems that are being studied in the many different territories which is comprehensive, accurate, objective and unbiased to a degree that is both extreme and admirable. It is an almost natural result of these commendable qualities that the picture conveys little impression of the fascination and romance of the applied research work which is going on in Africa, or of the scope which tropical Africa offers to even the humblest worker in the field of applied research to achieve something that will improve the lot or brighten the lives of millions of people, and, it might be added, of millions of people whom the worker generally soon learns to love.

The author apologises in his foreword for the extreme condensation of the account of the work which is going on in French and Belgian territories; and it is in this respect alone that the review fails to cover fully all the immense ground suggested by its title. The amount of space devoted to a review of the work in those territories is indeed very small compared to that devoted to the British territories. Since the Research Survey party apparently visited all the French and Belgian territories and investigated the work which is going on there, British workers in Africa will greatly regret that a more detailed account could not be given of the scientific activities there. Scientific workers in the British colonies have generally great difficulty in obtaining details of what is being done in their own subject in the French and Belgian colonies; and they also find it difficult to assess the real value even of the work of which accounts are published.

In the first chapter of the book (entitled "Some Problems of Research"), the extreme objectivity of the review is relaxed for a few pages and some interesting reflections and suggestions are made about the organisation and financing of research work in the Crown Colonies. One of the suggestions appears to be very dangerous. It is that the administrative sections of the agricultural, veterinary and forestry services, at least, if not of some others, should all be placed under one "Executive Head of Administration" and the research sections of these three departments similarly all under one "Executive Head of Research". In principle, with varying details, this same general idea has been put forward and considered on several occasions in the past both in the Colonies and in India. It has always been rejected because of the same fatal objection, that it would inevitably result in a marked cleavage between the field workers and the research workers in each department. Such a division is inevitable, in some degree, within each department; but all experience shows that this division introduces a source of danger which must be continuously guarded against if the research work is to be informed by first-hand knowledge of the practical problems of the country; and if, at the same time, the field work is to be as fully grounded as it should be upon the results of research. To accentuate this cleavage, deliberately and greatly, in the manner that is suggested on page 17 of this book, would therefore seem to be wrong in principle. There is also the practical objection of the difficulty, even the impossibility, of finding the man who can make a good executive head of the field sides of the agricultural, veterinary and forestry departments, and the not much less difficulty of finding a good director of research in all three subjects.

On pages 19, 20 and 21, there are some interesting reflections on the difference in the methods followed in British, French and Belgian colonies. "The British territories have permanent research "officers as members of the departments of "agriculture, medicine, &c. The number of such "officers is designed to be more than sufficient for "the routine work, so that some, at least, have "time for research. In the Belgian, and to a less "extent, the French systems, fewer permanent "scientific officers are employed in Africa, but an "extensive organization exists whereby special "surveys or scientific studies are undertaken in "Africa by missions sent out from Europe, often "arranged with the collaboration of universities. ". . . Clearly a combination of both methods "would be the ideal and one which should not be "hard to achieve. In the case of Great Britain "there seems to be scope for more co-operation on "the part of the universities". No one can quarrel with these suggestions put forward for the further improvement of the British system; but one cannot help hoping that, if Dr. Worthington had felt less necessity for caution in his statements, he might have reflected that so far the British system appears to have been more effective than the French.

To quote again: "Another instructive contrast "between the British and French colonies is that "in the former there sometimes appears to be a "certain lack of economy in apportioning the "work to be carried out by officers who have had

"a high scientific training. . . . Nevertheless, "these considerations point to one of the greatest "needs of Africa today, that of trained subordinate "staff. This lack is felt not only in agriculture, "but in every other branch of activity, and great "efforts are being made in many parts of the "continent to fill the gap by the higher education "of African natives". Dr. Worthington has undoubtedly found the right answer to this question. We think that no one with experience of the British colonies would favour the introduction into them of the French and Belgian system of employing, as field officers, Europeans of an inferior type in respect either of general education and standing or of technical training.

O. T. F.

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CATTLE FODDER AND HUMAN NUTRITION.

By Arturi I. Virtanen, *Cambridge University Press*, London, 1938. pp. 108, *Price 7s. 6d.*

This book comprises a series of four lectures, from a short course in biochemistry, given by the author at certain English Universities in November 1937. Lectures I and II covering the first half of the book provide an excellent précis of the present state of our knowledge regarding the process of symbiosis and nitrogen fixation by leguminous crops, with particular attention to the biochemical reactions. The third lecture is devoted to an analysis of the standard diet of the labouring classes in Finland at different seasons of the year. It is shown that although the diet is fairly adequate for proper nutrition during the summer, there are some marked deficiencies in the winter foodstuffs, chiefly in the vitamin-A and carotene contents, but also to a certain extent in vitamin-D. These deficiencies are traced to a lowering in the quality of the milk during the cold season, and this in turn is attributed to the type of ration fed to the milch cows during the winter. In Lecture IV a practical method of overcoming this lack of nutritive balance in the human and stock rations is suggested. Briefly, the method proposed involves the storage in the summer of a good proportion of leguminous herbage cut and ratooned sufficiently often to yield only a leafy type of forage of high nutritive quality.

The crux of the problem rests in using a storage technique which will preserve the bulk of the protein, mineral, and vitamin contents of the young fresh herbage. The author maintains that this can be effected practically and economically if the green produce is turned into silage by the well-known A.I.V. process which he himself originated. In this contention the author is not merely theorising as witnessed by the adequate data—derived largely from research at his own laboratories—which he quotes in support of his ideas. Artificial drying of the herbage which it is admitted would preserve the full nutritive quality of the fresh material is ruled out as impracticable on account of the high cost of production.

This series of memoirs makes thoroughly interesting and instructive reading, although the title of the book is rather broad and might be considered a little misleading. The main theme appears to be the advocacy of a wider use of the A.I.V. ensilage technique applied to leguminous types of forage crop of high nutritive quality. This would not only raise the standard of the winter rations of cattle in Finland but would also, as a direct result, eliminate certain obvious deficiencies in the diet of the working class section of the population. At a time when there is an increasing demand for closer co-operation between science and practice, Mr. Virtanen is to be congratulated on a noteworthy effort to demonstrate how the results of a prolonged period of close scientific investigation can be applied on a national scale for the material benefit of the community.

D. D. P.

ABSORPTION OF GROWTH PROMOTING SUBSTANCES BY CUTTINGS.*

About two years ago a batch of leafless cuttings of *Bougainvillea* (var Mrs. Louis Walthen) was received at these laboratories for propagation. They were planted in our usual propagators. The majority threw out small shoots but there was no callussing or root development. After eighteen months it was decided to try the effect of a proprietary root growth-promoting substance. The cuttings still alive were treated in the normal way, that is, by immersion of the basal ends in a dilute solution for eighteen hours. However, no callussing or rooting took place and it is assumed that this was due to lack of transpiration in the cuttings, which were leafless when treated.

Finally it was decided to try the effect of forcing the growth-promoting substance into the cuttings now almost exhausted of food reserves. The ends of the cuttings were cut off to expose fresh surfaces. The lower ends were submerged to a depth of one inch in the solution contained in a vacuum desiccator which was exhausted until a strong stream of bubbles emerged from the bottom end of each cutting. On breaking the vacuum the solution was forced into the submerged ends. Two or three months after replanting the cuttings, 90 per cent. rooted and are now healthy plants.

The experiment was not planned as a test of the growth-promoting substance, but was made in a final attempt to save the last remaining cuttings of a variety new to Kenya. So striking have been the results that the suggestion is put forward that possibly failure to secure rooting with winter cuttings of deciduous plants after treatment with various growth-promoting substances has been due to non-absorption, or to the absorption of too little of the material by the leafless cuttings.

* Letter to *Nature* (Vol. 141, No. 3575, p. 835, 1938), from T. H. Jackson, Scott Agric. Lab., Kenya.

SUGAR NOTES.

Compiled by the College Department of Sugar Technology.

Volatile Acids of Fermented Cane Molasses.—*By N. Srinivasan.*

The quantitative method followed is a slight modification and adaptation of the process described by A. Virtanen and Pulkki, and was performed as follows: To 1000 c.c. of neutral wash (freed from CO_2 and alcohol) the requisite amount of H_2SO_4 with about 100 grms. of sodium chloride were added, and the mixture steam distilled. Distillates were collected in 150 c.c. fractions, titrated against N/10 baryta and evaporated to about 150 c.c. The calculated quantity of H_2SO_4 was added, and the liquid made up to 250 c.c.; 200 c.c. of the clear solution were distilled, and two fractions of 50 c.c. each were titrated against N/20 alkali.

The qualitative estimation of the acids present in the steam distillates was made by Dyer's orientation tests and Peterson's cupric chloride chloroform test. Further, sodium salts of the "fore-shots" of the rectifying column were prepared and tested for acids. Practically each acid follows its own law of distillation and suitable equations are obtained and the acid present calculated.

Sample.	No. of hours after fermentation is complete.	Formic.	Acetic	Propionic	Butyric
		Grms. acid in 1 litre of wash.			
(1)	0	0.020	0.650	—	—
(2)	12	0.098	0.682	0.132	—
(3)	12	0.057	0.650	0.108	—
(4)	24	0.079	0.840	0.220	0.010
(5)	48	0.090	1.120	0.380	0.038

When fermentation is normal the increase in total acidity was found to be 1.0 to 1.5 grms. nearly half of which was due to volatile acids, the nature and quantity of which are given in the above table. Formic, acetic and propionic are invariably present. Formic acid, as Wilson points out is derived from the molasses and the autophagy of yeast. The other acids are produced by the action of the yeast and bacteria. The sodium salts of the fore-shots from the stills indicated large quantities of sulphurous acid, present to the extent of 0.06 to 0.08 grms. of SO_2 per 100 c.c. along with other volatile acids on top of the rectifier.

On account of its extreme solubility in water and in alcohol (30 c.c./c.c. water and 95 c.c./c.c. alcohol at 27°C.) a large quantity of the liberated SO_2 is returned to the top of the rectifying column with the reflux from the condensers. The esters of the volatile acids with alcohol and the acids comprise the "head products" or "fore-shots", which impurities are eliminated in patent Barbet stills.—(*Int. Sugar Jr.*, Vol. XLI, No. 482, p. 68, 1939.)

* * *

A Contribution to Raw Sugar Clarification.—*By J. G. Davies.*

Opinion has been expressed that the low claribility of P.O.J. 2878 cane is due to the varying stages of maturity at which it is usually delivered to the mill. A series of determinations carried out during the growing period and compared to a similar series from a high claribility juice (B.H. 10 [12]) failed to show any profound differences in the organic colloid content. The ash content of a low claribility juice does, however, appear to be greater than that of a high claribility juice. In examining the phosphate status, it was observed that there is a characteristic residual phosphate content of the clarified juice in different varieties, even with fluctuating amounts in the raw juice. This observation points to the possibility of an organo-phosphate compound being present in the juice which withholds a portion of the P_2O_5 from the juice reactions. The clarified juice of P.O.J. 2878 contains a larger amount of P_2O_5 per cent. total solids than the clarified juice of B.H. 10(12) and hence less is available for the formation of a calcium phosphate precipitate.

The rôle of silica was then examined, a method being adapted for use so that the inorganic silica could be estimated separately, and the organic silica as the difference between this and the total silica. The analyses were undertaken on a series of juices from five varieties of different degrees of claribility. The results, expressed both as organic silica per cent. total solids and organic silica per cent. total silica, show that the organic silica increases with decreasing claribility. This phase of the work is not yet finished, and further evidence is required to show the full significance.

The process known as fractional liming and double heating has now been put on a practical basis. It consists of first liming the raw juice to pH 6.3, heating to 212°F., liming to pH 7.5 and finally heating to 212°F. again. The primary heating to 212°F. may require to be reduced to 200°F. No extensive changes are required in factory equipment and the extra heating capacity for secondary heating is small. The benefits to be derived are more apparent with low claribility juices. They may be described as rapid settling of the precipitate, low mud volumes, and a possible saving in lime. The desired results are therefore obtained by the more efficient use of heat rather than by the addition of larger amounts of chemicals.—(*Facts about Sugar*, Vol. 34, No. 1, p. 38, 1939.)

CHEMICAL NOTES.

Compiled by the College Department of Chemistry and Soil Science.

Vitamin D and Cacao Shell.*

The vitamin D potency of milk-chocolate not completely accounted for by the vitamin D of the milk present, led to the discovery by Knapp and Coward of the fact that cacao nib has a vitamin D potency of one international unit per gram. This unusual vitamin D potency in a vegetable product evoked considerable interest and further research by these workers showed that cacao shell had at least one-quarter of the vitamin D content of codliver oil. The value of cacao shell as a feeding-stuff for cows and other animals has also been tested at the National Institute for Research in Dairying at Reading, where Kon and Henry found that the vitamin D in the cacao shell consumed by cows was largely conveyed to the butter. The feeding of 2 lb. of cacao shell per cow daily in winter not only led to an increase in vitamin D potency of the milk and butter from winter to summer level, but was accompanied by an increase in the fat content of the milk. This has been confirmed in the researches of Golding and Burr and in the large-scale farm feeding tests of Knapp and Churchman. The high vitamin D content of cacao shell came as a surprise to the scientific world, and further work both in this country and on the Continent, fully confirmed the discovery. Achcenich, in particular, has carried out extensive tests and reports figures as high as 125 I. units of vitamin D per gram of cacao shell.

From investigations on the origin of vitamin D in cacao shell it was concluded that the presence of either vitamin D or ergosterol in the fresh shell of the cacao bean was impossible. During the fermentation process, *yeast*, containing ergosterol, develops in the pulp on the shell, and this, during the drying process in the tropical sun, is converted into vitamin D. Hence, vitamin D is absent from artificially-dried cocoa, whereas in the fermented and sun-dried cacao of commerce the vitamin D of the cacao shell is very high;—twenty or thirty times as potent as in dairy butter. Negative results in feeding tests with poultry confirm that the vitamin D of cacao shell is similar to calciferol or irradiated ergosterol, and should be called vitamin D2. (*Inst. of Chem. Jr. & Proc.* Pt. VI, pp. 458-59, 1939.)

* * *

Indian Paper Industry.

The progress made by the paper industry in India under the scheme suggested in the Bamboo Paper Industry (Protection) Act has justified the policy of discriminating protection sanctioned by the Government of India. During the period 1924-25 to 1936-37, the production of writing and printing papers by Indian mills increased from 23,331 to 43,951 tons, nearly 88 per cent., while imports of the "protected" varieties decreased from 20,039 to 11,839 tons, nearly 41 per cent. Imports consist of superior and special varieties of writing and printing papers, the manufacture of which has not hitherto been undertaken by the Indian mills. The expansion of the writing and printing paper industry in India during the last 12 years has been based largely on the use of indigenous raw materials, such as bamboo and grass, which was stimulated by imposition in 1932 of the protective duty on imports of wood pulp. There is a vast scope for the manufacture of printing, wrapping, packing, newsprint, and cheap printing papers, and boards of various kinds in this country.

A readjustment of the tariff schedules for the import of mechanical wood pulps and old newspapers may induce the establishment of mills for the manufacture of these papers in the immediate future, and a reasonably liberal expenditure on research is in the long run more economical to the tax payer than the indefinite continuance of protection or subsidy.—(*Ind. & Eng. Chem., News Edit.*, Vol. 16, No. 24, p. 669, 1938.)

* * *

Direct Oxidation of Soil Humus.

Mr. C. B. Greening has published a preliminary account of the use of potassium permanganate for the oxidation of soil humus (*J. Roy. Hort. Soc.*, September, 1936). He has now followed it by a more extensive paper (*J. Roy. Hort. Soc.*, **63**, Pt. 12, December, 1938). Garden refuse can be oxidised to organic manure by treatment of a heap with permanganate solution (1 oz. per gall. of water). More dilute solutions were applied to lawns, where they stimulated the growth of grass, eradicated moss, destroyed "mat" and controlled earthworms. Tomatoes and zonal Pelargoniums grew better than normal when treated with still weaker solutions. The action of oxidizing agents might vary with soil type, or with acidity, and such possibilities have still to be appraised. Effects of the treatment have as yet, moreover, been estimated by the unaided eye; but a promising field of practical application is undoubtedly commended for further detailed investigation.—(*Nature*, Vol. 143, No. 3613, 1939, pp. 167-8.)

* * *

Artificial Silk made from Cotton Linters.

The Indian Central Cotton Committee has been carrying on experiments in the first stage of artificial silk production by the acetate process and is determining the cost of producing chemical cotton from cotton linters, of which it is believed about 10,000 tons are now annually wasted in ginning and spinning.—(*Ind. & Eng. Chem., News Edit.*, Vol. XVI, No. 19, p. 529, 1938.)

* Summary of Lecture given by Dr. A. Churchman to the Bristol and South-Western counties at Bristol University, from Dr. A. W. Knapp's notes.

TREND OF THE MARKETS.

[The notes below are based principally upon running charts of the prices of the basic grades and upon general statistical information gleaned from contemporary publications and cablegrams and are intended to be a record of movements. An attempt is made, where possible, to indicate the market outlook at the time of going to press, but no responsibility for the accuracy and subsequent truth of such observations is assumed. Unless otherwise stated the prices quoted are spot, London.]

SUGAR.—Prices on the Home Markets have ranged as follows (c.i.f. per cwt.) :—

	Foreign.		Preferential.	
	s.	d.	s.	d.
26th January ...	6	3¾	10	0¾
2nd February ...	6	3	10	0
9th February ...	6	3	9	11¼
16th February ...	6	1½	9	11¼
23rd February ...	6	1½	9	2⅛
2nd March ...	6	2¼	9	11¼
9th March ...	5	6	10	0¾
(10th March, 1938) ...	5	3	8	11¼

Since our last report the market has been distinctly dull and, with actual raws in generally poor demand, prices have shown a sagging tendency.

* * *

RUBBER.—Quotations for plantation sheet have ranged as follows :—

	Pence per lb.
25th January	7 13/16
1st February	7 7/8
8th February	7 11/16
15th February	8 1/16
22nd February	8 1/8
1st March	8 5/16
8th March	8 3/8
(9th March, 1938)	6 15/16

On 14th February a meeting of the International Regulation Committee was held at which it was decided to leave the export quota for the April-June quarter unchanged at 50 per cent. of the basic tonnage. The Committee's decision is regarded as creating a definite favourable outlook for the market which has remained firm since the announcement. American consumption at 46,234 tons for January is about as expected.

* * *

COFFEE.—Santos Superior :—31*s.* per cwt. cost and freight and No. 7 Rio 22*s.* 6*d.* Costa Rica :—bold sized London cleaned from 67*s.* to 120*s.*; country cleaned 74*s.* to 96*s.* 6*d.* Kenya :—"A" sizes from 68*s.* to 126*s.*; the greater portion realising over 75*s.*, "B" sizes from 60*s.* to 86*s.*, and "TT" from 54*s.* 6*d.* to 66*s.*

* * *

LIME PRODUCTS.—*Lime Oil.*—Handpressed has a nominal value of 27*s.* 6*d.* per lb. Distilled is in poor demand and the market is over supplied. Quotations are about 12*s.* 6*d.* per lb. *Lime Juice.* There is a very limited demand for clean and fluid Concentrated. Raw is rather lower in price and is valued at 1*s.* 9*d.* to 2*s.* per gallon.—(*West India Committee Circular*, 23rd February, 1939.)

COTTON.—The following are the official spot prices in pence per lb. of the Liverpool Cotton Association :—

	American Mid.	Egyptian Giza 7.	F.G.F. Sakel.
27th January ...	5.10	7.25	7.20
3rd February ...	5.13	7.40	7.35
10th February ...	5.07	7.02	6.97
17th February ...	5.15	6.91	6.91
24th February ...	5.18	7.02	7.02
3rd March ...	5.29	—	—
10th March ...	5.40	—	—
(11th March, 1938)	5.06	7.48	8.43

The tone of the market has been better largely owing to the improved situation in Europe. The raw cotton market remains dominated by uncertainty concerning the future of the agricultural policy of the U.S.A. Government. A few bales of West Indian Sea Island cotton have been sold at prices ranging from 18½ to 19 pence per lb.

* * *

COCOA.—The market in consuming centres showed slight activity during the past month. The outstanding feature was the noticeable increase in speculative purchases which is entirely warranted by the favourable position of the market. Reports from Accra state that the harvesting of cocoa has been completed in all districts. It is officially estimated that over 90 per cent. of the crop has been marketed. Accra cocoa is now quoted at 21*s.* c.i.f. and locally $7.25 per fanega is paid for Plantation marks.—(*By courtesy of the Cocoa Planters' Association of Trinidad, Ltd.*)

* * *

BANANAS.—The market has improved but prices have remained unchanged at £17 10*s.* delivered London and £17 5*s.* delivered nearest station Provinces. The demand for Brazilians is good and the price has risen to £15 delivered both in London and the Provinces.

* * *

SPICES.—*Pimento* is unchanged at 69*s.* c.i.f. for February/March buyers. Sellers quoting 70*s.* Spot quiet 8*d.* per lb. ex store. *Ginger* is dull with spot business in London passing at 30*s.* per cwt. for Small No. 3 and Mixed Small No. 2 at 32*s.* 6*d.* to 35*s.* *Nutmegs.*—Sound unassorted and slightly defective are quoted at 4¼*d.* and Sound 80's at 5¾*d.* with wormy and broken at 2¾*d.* *Mace.*—The market is steadier and there has been more inquiry from the trade. For mixed red to pale, the spot price was 1*s.* 5*d.* to 1*s.* 6*d.*, whilst for palish to pale it was 1*s.* 7*d.* to 1*s.* 8*d.*—(*West India Committee Circular*, 23rd February, 1939.)